Appendix J-- ENR Chemical Treatment Unit Design

The design of the chemical treatment units for the Phase 1 testing at the ENR was completed in the fourth quarter of 1999. Final modifications to the design were completed after a vendor was selected. Pilot plants were ordered in late October for delivery in early January 2000.

J.1 Description of Pilot Plants

There are three pilot plants – 2 at the north ENR site and 1 at the south ENR site. At the north ENR site, one plant is an iron plant and pretreats water directed to cell 2. The other plant is an aluminum plant and pretreats water to cell 4. Cell 3 at the north ENR is the control cell and receives water (from the pilot plant splitter box) that has not been chemically treated. The single pilot plant at the south ENR site can be directed to flow to either cell 5 or cell 7. Cell 6 at the south ENR site will be the control cell.

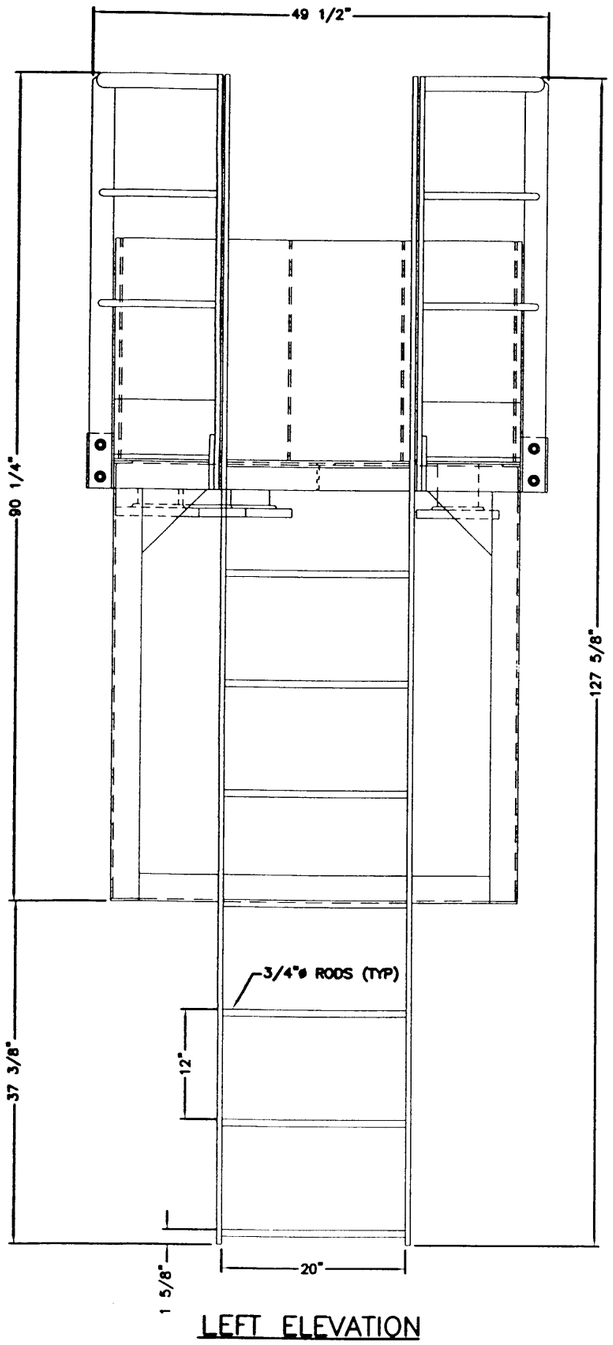
Influent to the pilot plants flows from a three way splitter box as depicted in Exhibit 6-1. Each effluent basin on the splitter box flows to a different system; the iron coagulant system, aluminum coagulant system or a control cell. The target raw water flow rate of 20 to 50 gallons per minute (gpm) to each pilot plant/wetland cell is achieved by using a 10° V-Notch weir with a design head of up to 12-inches. The V-notch weirs are adjustable up or down individually to increase or decrease flow to the three systems. Water overflowing the 18-inch sharp crested rectangular weir water is diverted to an overflow basin. The overflow basin drains to the perimeter borrow ditch on the outside of the ENR cells.

The pilot plants include two duplex 120V outlets with 20amp GFI's for sampling equipment, lights, etc. Controls for the mixers and pumps are localized at a control panel. Mechanical wetted parts such as mixer shafts and impellers are fabricated of 316SS. Process tank components are of carbon steel with a high performance coating system. The pilot facility was designed to operate under gravity flow from the splitter structure through the sludge storage tanks and into the test cells under all conditions.

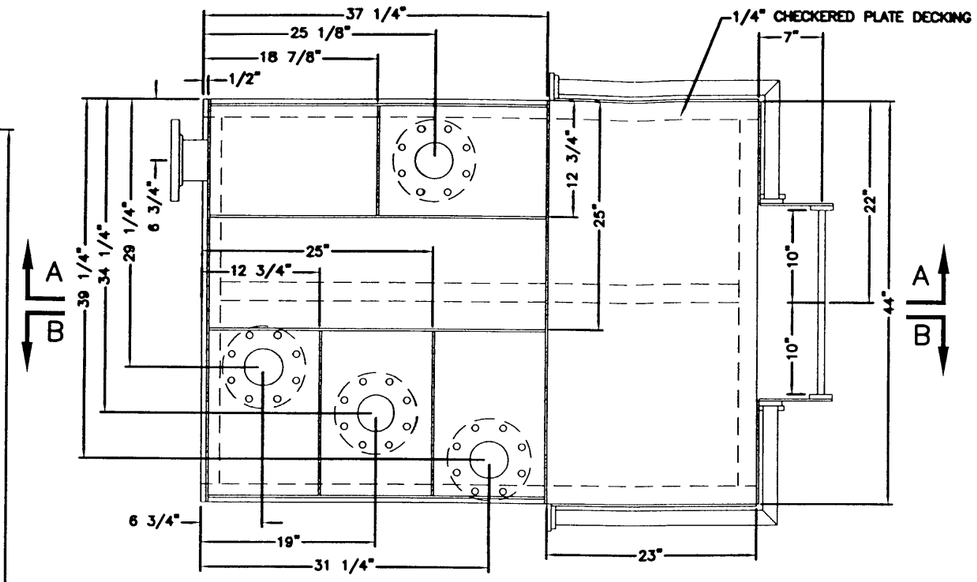
J.2 Pilot Plant System

The remaining description pertains to a typical pilot plant system. A process flow diagram is shown in attached Exhibit 6-2. A typical plan and profile of the systems is shown in Exhibit 6-3.

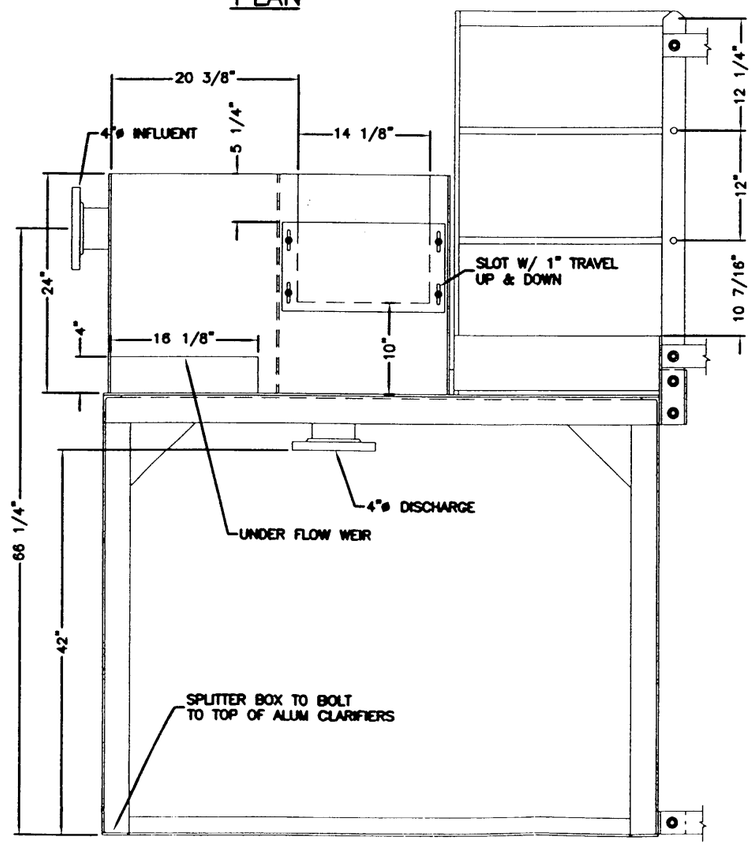
From the splitter box the influent flows into the first of two rapid mix tanks. Both rapid mix tanks have volumes of approximately 20 gallons and are fitted with fixed speed mechanical mixers with axial flow type rapid mix impellers. These tanks are rectangular which discourages rotation of the liquid contents. Coagulant is introduced to the first rapid mix tank, and polymer is added to the second.



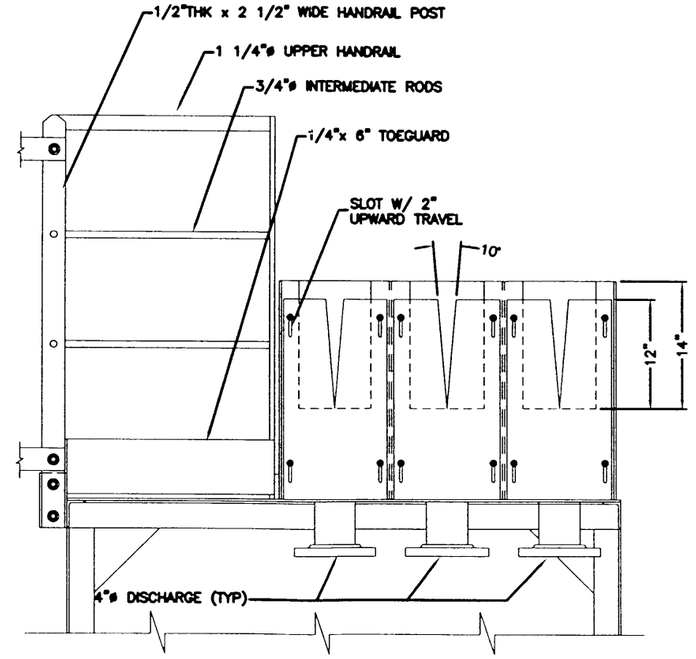
LEFT ELEVATION



PLAN



SECTION A–A



SECTION B–B

SHIPPING WT = 1350 LBS
OPERATING WT = 2660 LBS

FT 0 1 2

CM 0 50

Rev.	By	Date
Drawn By	DA	Date 11/11/99
Project Engr.		Approval Date
Job No.	CH2-01	Code No. 096

Proprietary Information

This document contains Hoffland Environmental Inc. proprietary information which may not be used for the benefit of others except by expressed permission of Hoffland Environmental Inc.

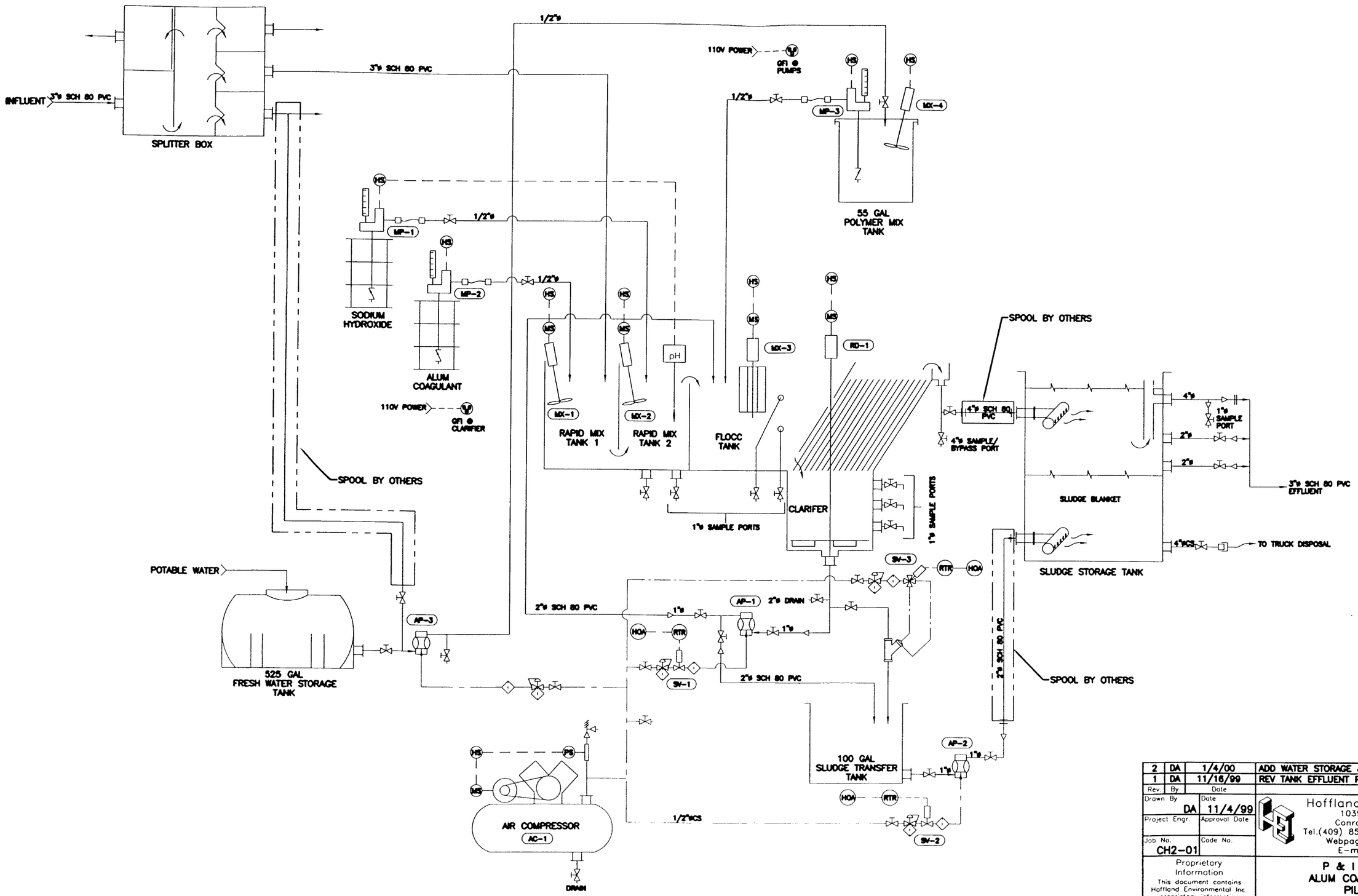
Description

Hoffland Environmental Inc.
10391 Silver Springs Rd.
Conroe, Texas 77303 USA
Tel.(409) 856-4515 Fax.(409) 856-4589
Webpage: www.hofflandenv.com
E-mail: hoffland@flex.net

SPLITTER BOX FOR ALUM COAGULANT SYSTEMS (2 REQ'D)
CH2MHILL

EXHIBIT 6-1

Scale		Sheet	Rev
1 1/2"=12"	Y-067-TK-01	1	0



Rev.	By	Date	Description
2	DA	1/4/00	ADD WATER STORAGE & AP-3 PUMP
1	DA	11/16/99	REV TANK EFFLUENT PIPE FROM 3"ø TO 4"ø

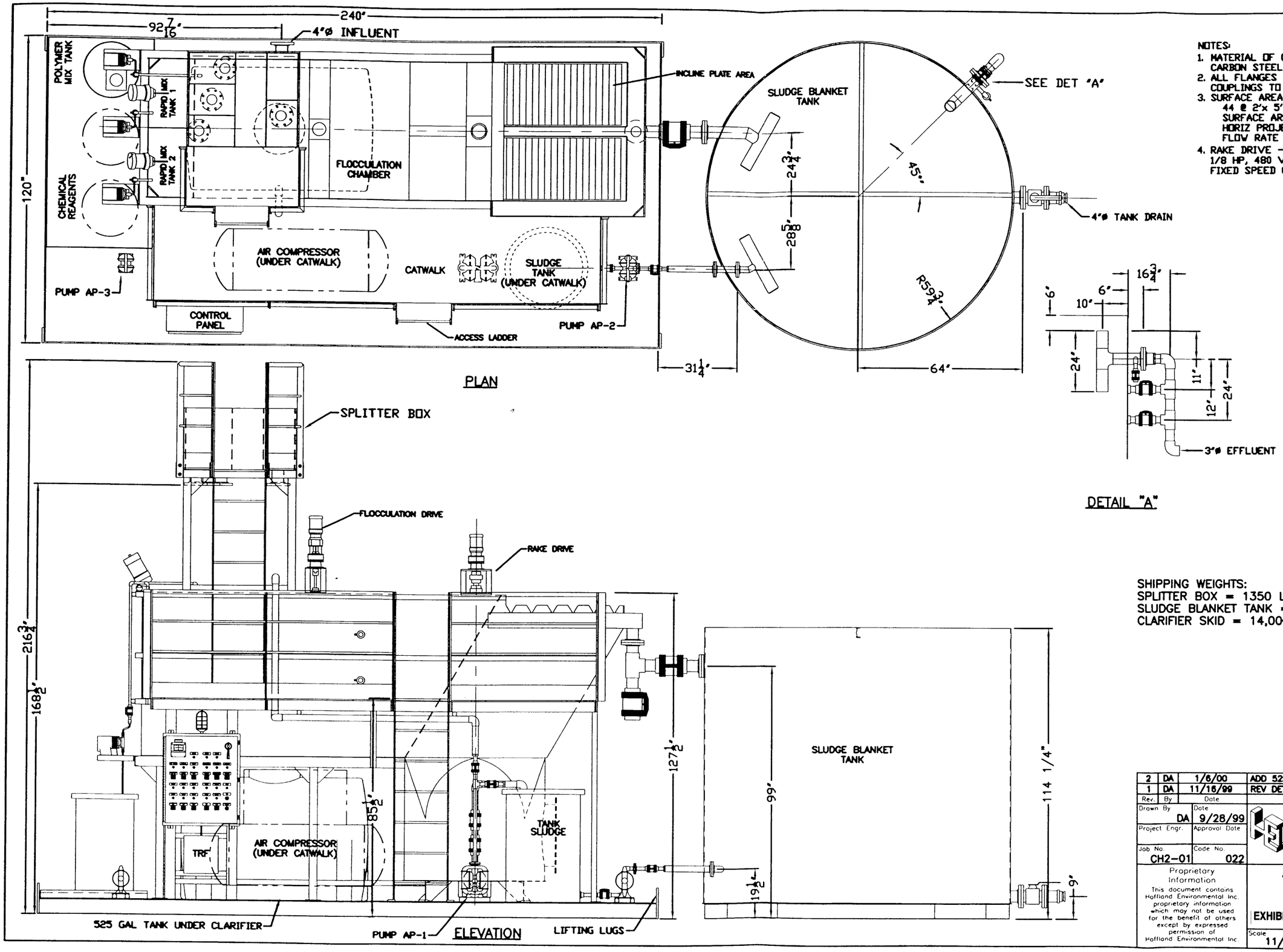
Drawn By: DA	Date: 11/4/99
Project Engr.	Approval Date
Job No.: CH2-01	Code No.

Hoffland Environmental Inc.
10391 Silver Springs Rd.
Conroe, Texas 77303 USA
Tel.(409) 856-4515 Fax.(409) 856-4589
Webpage: www.hofflandenv.com
E-mail: hoffland@flex.net

P & I DIAGRAM FOR ALUM COAGULANT SYSTEM PILOT PLANT CH2MHILL

EXHIBIT 6-2

Scale		Sheet	Rev
1=1	Y-067-PI-01	1	2



DETAIL "A"

NOTES:
1. MATERIAL OF CONSTRUCTION TO BE ASTM A-36 CARBON STEEL 1/4" THICK PLATE
2. ALL FLANGES TO BE 150 LB RAISED FACED AND ALL COUPLINGS TO BE FNPT
3. SURFACE AREA SPEC'S:
   44 @ 2'x 5' FRP PLATES
   SURFACE AREA = 440 SQ FT
   HORIZ PROJECTED AREA = 220 SQ FT
   FLOW RATE = 55 GPM
4. RAKE DRIVE - 52"ø RAKE W/ 1/8 HP, 480 VAC, 3 PHASE TEFC MOTOR AND FIXED SPEED GEAR DRIVE

SHIPPING WEIGHTS:
SPLITTER BOX = 1350 LBS
SLUDGE BLANKET TANK = 5,000 LBS
CLARIFIER SKID = 14,000 LBS

Rev.	By	Date	Description
2	DA	1/6/00	ADD 525 GAL TANK AND 1/2" PUMP
1	DA	11/16/99	REV DET "A" PIPE FROM 3"ø TO 4"ø

Drawn By: DA — Date: 9/28/99
Project Engr. — Approval Date
Job No.: CH2-01 — Code No.: 022

Hoffland Environmental Inc.
10391 Silver Springs Rd.
Conroe, Texas 77303 USA
Tel.(409) 856-4515 Fax.(409) 856-4589
Webpage: www.hofflandenv.com
E-mail: hoffland@flex.net

ALUM EQUIPMENT ARRANGEMENT
(2 REQ'D)

CH2M HILL

EXHIBIT 6-3

Scale: 11/16=12 — Y-067-FL-01 — Sheet: 1 — Rev: 2

The coagulant feed system consists of a diaphragm metering pump (0-2 gallons per hour [gph]) with manual stroke length and speed/frequency adjustment. Coagulant is fed neat from 55-gallon drums. The polymer feed system consists of a diaphragm metering pump (0-3 gph) with manual stroke length and speed/frequency adjustment, and a polymer makeup system consisting of a 50-gallon polyethylene tank with integral mechanical mixer. Approximately 50 gallons of 0.5 percent solution are made up every other day from neat emulsion. Each metering pump includes a 500 mL calibration chamber.

Fifty percent NaOH solution is injected into the iron coagulant system immediately upstream of the coagulant injection point in rapid mix tank one (no pH adjustment is required for the blank cell or the aluminum system). The pH control system consists of the pH analyzer element, indicator/transmitter, pH controller, and 0-2 gph electric diaphragm metering pump with variable stroke and speed controlled by the controller to achieve the target pH setpoint.

From the rapid mix tanks the flow continues into the flocculation tank. The floc tank also receives recirculated sludge flow from the plate settler. The floc tank has a volume of 1,500 gallons and is mixed using a variable speed geared mixer with a fence type flocculating impeller providing a G value ranging from <30 to >70 s^{-1}. The tank is rectangular which prevents the bulk liquid from turning as a unit.

From the floc tank the chemically treated water passes to the plate settler. The plate settler has a projected horizontal plate area/effective surface area of 220 square feet. The plate settler is equipped with V-notch weirs to ensure equal distribution through the plates.

The underflow line from the plate settler is split into separate recycle and waste sludge lines, with each line having a manual ball valve to select the direction of flow. Typically, flow is directed back to the floc tank. Operations staff manually open the waste sludge valve periodically (and close the recirculation valve) in order to waste a predetermined volume of sludge into the 100 gallon calibrated waste sludge measuring tank.

Recirculated sludge flow is controllable through a timer to as much as 30 gpm continuously. The recirculation pumps are currently set to pump at a rate of approximately 8 gpm, and are on for 30 seconds and off for 90 seconds. Thus, 8 gallons are pumped every 2 minutes, or approximately 4-gpm equivalent continuous flow. This flow rate is being increased gradually to maintain a low sludge blanket depth in the plate settler (keep solids in the floc zone).

Both the effluent from the plate settler, and wasted sludge, are directed to the 5,000 gallon sludge storage tank. Wasted sludge is transferred from the waste sludge measuring tank into a diffuser in the bottom of the sludge storage tank using a solids transfer pump with local on/off control having a flow rate of up to 20 gpm. The intent is to accurately measure the amount of sludge wasted using the calibrated waste sludge measuring tank, and then transfer this sludge to the storage tank without causing the storage tank to be stirred up.

Clarified effluent flows by gravity to the same sludge storage tank and is diffused through a header at the top of the tank so as not to disturb the sludge blanket beneath it. The intention is that sludge is allowed to accumulate in this tank, with clarified liquid flowing over the top of the sludge. There is a scum baffle to prevent floating scum from exiting with the effluent liquid from this tank. Effluent from pilot units flows by gravity to their respective

cells. The sludge storage tanks are fitted with 6-inch quick disconnect fittings to accommodate transfer of sludge to a hauling truck through a flexible hose.